

Rec'd PCT/PTO 09 MAY 2005

PCT/GB 2003 / 0 0 4 7 55



INVESTOR IN PEOPLE

10/534394

The Patent Office

Concept House

Cardiff Road

Newport

South Wales

NP10 8QQ

DEC 2003

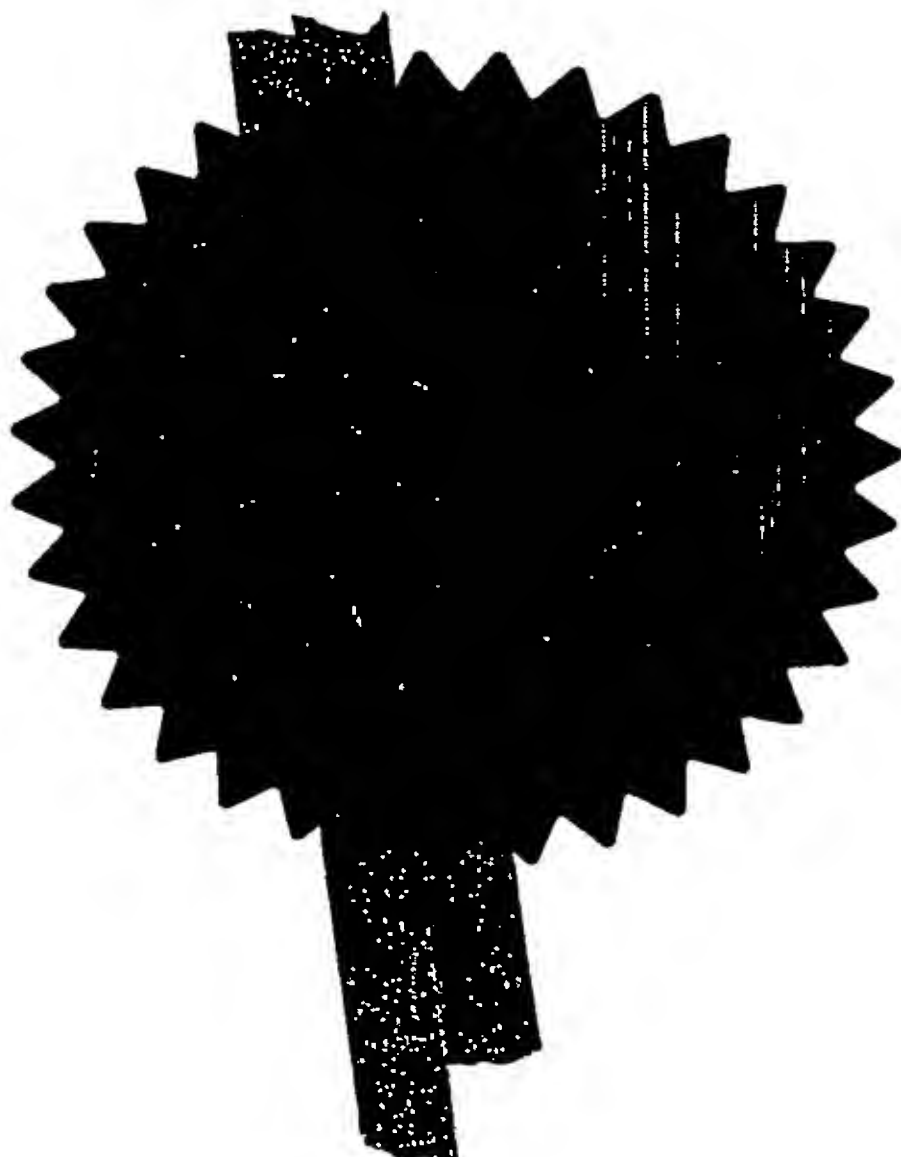
PCT

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.



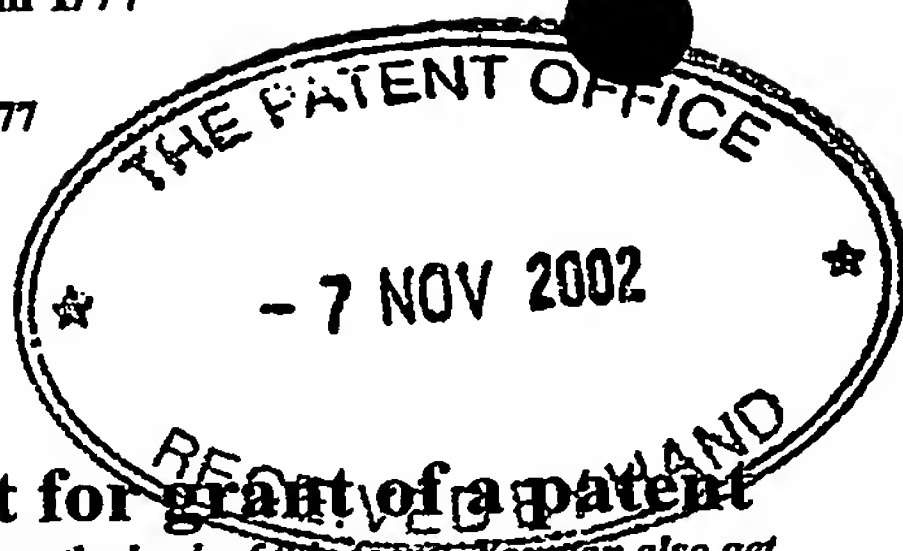
L. Mahoney

Signed

Dated 25 November 2003

**PRIORITY
DOCUMENT**

SUBMITTED OR TRANSMITTED IN
COMPLIANCE WITH RULE 17.1(a) OR (b)



The Patent Office

08NOV02 E761844-2 D01039
P01/7700 0.00-0226003.2

1/77

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office
Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference	P104254GB/MPG/48533 07 NOV 2002		
2. Patent application number (The Patent Office will fill in this part)	0226003.2		
3. Full name, address and postcode of the or of each applicant (underline all surnames)	TTPCommunications Limited Melbourn Science Park Cambridge Road Melbourn Royston Hertfordshire SG8 6EE Patents ADP number (if you know it) --- If the applicant is a corporate body, give the country/state of its incorporation United Kingdom		
4. Title of the invention	PREPARATION OF SIGNALS FOR DECODING		
5. Name of your agent (if you have one) "Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)	WITHERS & ROGERS Goldings House 2 Hays Lane London SE1 2HW Patents ADP number (if you know it) 1776001		
6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or each of these earlier applications and (if you know it) the or each application number	Country	Priority application number (if you know it)	Date of filing (day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application	Date of filing (day / month / year)	

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (answer 'Yes' if: a) any applicant named in part 3 is not an inventor, or b) there is an inventor who is not named as an applicant, or c) any named applicant is a corporate body. See note (d))	YES		

8356727001

9. Enter the number of sheets for any of the following items you are filing with this form.
Do not count copies of the same document

Continuation sheets of this form

Description	6
Claim(s)	2
Abstract	1
Drawing (s)	4

10. If you are also filing any of the following, state how many against each item.

Priority documents	---
Translations of priority documents	---
Statement of inventorship and right to grant of a patent (Patents Form 7/77)	---
Request for preliminary examination and search (Patents Form 9/77)	1
Request for substantive examination (Patents Form 10/77)	---
Any other documents (please specify)	---

11. I/We request the grant of a patent on the basis of this application.

Signature

Withers & Rogers
WITHERS & ROGERS

Date 6th November 2002

12. Name and daytime telephone number of person to contact in the United Kingdom

Matthew GILLARD

0117 925 3030

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least six weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

- If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500 505.
- Write your answers in capital letters using black ink or you may type them.
- If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.
- If you have answered 'Yes' Patents Form 7/77 will need to be filed.
- Once you have filled in the form you must remember to sign and date it.
- For details of the fee and ways to pay please contact the Patent Office.

PREPARATION OF SIGNALS FOR DECODING

The invention relates to the field of wireless-communications networks. For example, the invention finds application in a network organised according to the UMTS (Universal Mobile Telecommunications System) standards. In particular, the invention is concerned with the receiver architecture of a participant in a wireless-communications network, such as a base station or a mobile telephone.

Figure 1 shows a block diagram of a receiver chain for a UMTS mobile telephone 10. Radio frequency signals transmitted to the telephone 10 are received on antenna 12 and passed to demodulator 14. In the demodulator 14, spread-spectrum signals are extracted from their radio frequency carrier signals and are sent to a digital to analogue converter (DAC) 16. The digitised spread-spectrum signals are then sent to a rake receiver 18. The rake receiver identifies multi-path components within the spread-spectrum signals, despreads the multi-path components and combines them to produce an encoded signal at the chip rate consisting of a series of soft decisions. The encoded signal is then operated on by scaling unit 20 which applies a scaling factor to the soft decisions constituting the encoded signal. The scaled version of the encoded signal output by the scaling unit 20 is then passed to a codec 22 (an encoder-decoder). The codec 22 decodes the encoded signal using a process such as the Viterbi algorithm. The codec 22 outputs a symbol-rate message signal as a result of the decoding process. The message signal then undergoes further processing within the telephone 10, as indicated by processor block 24. For example, the message signal could indicate digitised speech which requires additional processing to convert it into an analogue signal which can be emitted from a loudspeaker (not shown) forming part of the telephone 10.

As mentioned above, the scaling unit 20 scales the soft decisions that are produced by the rake receiver 18 for decoding in the codec 22. A certain degree of scaling is required to optimise the operation of the codec 22. The scaling unit 20 controls the degree of scaling that it applies to the soft decisions by monitoring its own output on feedback path 26. That is to say, the scaling unit 20 monitors the scaled soft decisions that it sends to the codec 22

and uses the monitored soft decisions in an algorithm which determines how the degree of scaling should be adjusted.

The details of the operation of the algorithm are not important and can vary from one implementation to another. However, the algorithm will produce an output in the form of an adjustment to be made to the scaling factor that is applied to the soft decisions and this output is derived by monitoring the power of the soft decisions arriving on the feedback path 26. A significant disadvantage of this approach will now be discussed.

Figure 2 is a plot of a digital signal with amplitude and time represented on the vertical and horizontal axes, respectively. In Figure 2, the signal comprises a series of digital samples, issued at a rate of one sample per unit of time. The power, P , contained in the signal shown in Figure 2 is simply the sums of the squares of the amplitudes of the individual samples making up the signal, divided by the number of samples:

$$S = 0^2 + 1^2 + 2^2 + 3^2 + 2^2 + 1^2 + 0^2 + 1^2 + 2^2 + 3^2 + 2^2 + 1^2 + 0^2 + 1^2 + 2^2 + 1^2 + 0^2 + 1^2 = 45$$

$$P = 45/18 = 2.5$$

Figure 3 shows what would happen if the signal of Figure 2 became saturated at an amplitude of 2. The power of the saturated signal can also be calculated:

$$S = 0^2 + 1^2 + 2^2 + 2^2 + 2^2 + 1^2 + 0^2 + 1^2 + 2^2 + 2^2 + 2^2 + 1^2 + 0^2 + 1^2 + 2^2 + 1^2 + 0^2 + 1^2 = 35$$

$$P = 35/18 = 1.9$$

It will be seen that when the signal becomes saturated at an amplitude of two, the power value is drastically different to the power value that is obtained when the signal is not saturated. Therefore, in situations where the signal might become saturated, the value of the power of the signal might not be a good parameter to monitor.

Sometimes, in the receiver chain shown in Figure 1, it is desirable to use a certain form of decoding algorithm within the codec 22, this algorithm being of a kind whose accuracy is increased if the signal that it operates on is partially saturated. Therefore, the situation can arise where the scaling unit 20 is intentionally inducing partial saturation of the soft decisions provided by the rake receiver 18. In this situation, a problem arises if the algorithm used to scale the soft decisions relies on the power of the soft decisions that are monitored on feedback path 26. That is to say, because the power value for any given signal monitored on feedback path 26 can vary tremendously depending upon the degree of scaling being applied to the signal, the power of the signal monitored on path 26 is not always a reliable parameter to use for controlling the algorithm which scales the soft decisions.

One aim of the present invention is to ameliorate, at least in part, the disadvantage discussed above.

According to one aspect the invention provides a method of conditioning signal values being conveyed to a decoder in a wireless-communications network participant, the method comprising scaling the values, monitoring the probability distribution of the amplitudes of the scaled values and using the information gained through the monitoring step to determine if the degree of scaling should be adjusted.

The invention also consists in a wireless-communications network participant, comprising a decoder for decoding a signal received at the participant, scaling means for scaling values of the signal being conveyed to the decoder, monitoring means for monitoring the probability distribution of the amplitudes of the scaled values and control means for using information supplied by the monitoring means to determine if the degree of scaling should be adjusted. Such a method can be implemented by a computer program. Such programs can be accommodated by an appropriate data carrier, such as a read only memory.

Thus, the invention provides an alternative scheme for scaling a stream of signal values which is less effected by saturation.

In one embodiment, the probability distribution of the scaled values is monitored by determining the fraction of a group of signal values that exceed a certain amplitude.

The invention can be used, for example, in a participant of a 3G telecommunications network and the decoder is a bit-rate signal decoder using, for example, the Viterbi or max log-MAP algorithm.

By way of example only, an embodiment of the present invention will now be described with reference to the accompanying figures, in which:

Figure 1 is a block diagram of a receiver chain in a UMTS mobile telephone;

Figure 2 is a plot of a group of soft decisions representing a section of a signal;

Figure 3 is a plot of the signal of Figure 2 in a partially saturated condition;

Figure 4 is a plot of the amplitude of the soft decisions of Figure 3;

Figure 5 illustrates the performance of a probability distribution measurement on the wave form of Figure 4; and

Figure 6 illustrates the performance of a probability distribution measurement on a trace representing the amplitude of the signal shown in Figure 2.

In the embodiment that will now be described, the power of the signal on path 26 is not the parameter which is used to control the algorithm which scales the soft decisions. Instead, a parameter based on the cumulative probability density function (CDF) of the signal is used. In fact, the parameter that is used to control the scaling algorithm is 1-CDF and is hereinafter termed the complementary CDF and is referred to as Q for ease of reference.

The CDF for a given amplitude value of a digital signal is the ratio of the number of samples in the signal where the amplitude is equal to or less than the given value versus the total number of samples in the signal. The parameter Q is the ratio of the number of samples where the amplitude value exceeds the given value versus the total number of samples in the signal. That is to say, $CDF + Q = 1$.

To illustrate the calculation of the parameter Q , we will use the example of the saturated signal of Figure 3. Figure 4 is a plot of the *amplitude* of the saturated signal of Figure 3 versus time. In this example, we will calculate $Q [1]$, which is to say the ratio of the number of samples where the amplitude exceeds 1 versus the total number of samples.

Figure 5 illustrates this calculation. As can be seen in Figure 5, the amplitude of the signal exceeds the value 1 on 7 occasions (as indicated by the vertical arrows) out of the 18 amplitude points shown. Therefore, $Q [1] = 0.389$ for the signal shown in Figure 5.

Figure 6 shows what the calculation of Figure 5 would have been like if the signal had not been saturated. Again, the amplitude of the signal exceeds the value 1 on 7 occasions (as indicated by the vertical arrows) out of the 18 sample points. Therefore, the result for $Q [1]$ is unchanged by saturation in this example.

Therefore, it follows that CDF, or CDF based measurements, can be used to make an assessment of the amplitude profile of a signal without being grossly effected by saturation. Of course, the degree of effect that saturation has on a CDF or Q value depends on the amplitude value at which saturation occurs relative to the amplitude at which the CDF or Q function is evaluated. For example, if the amplitude value of saturation is less than the amplitude value at which Q is evaluated, then the Q value will be significantly distorted by saturation. Therefore, it is important to keep the amplitude value at which the Q function is calculated to a level below the saturation limit.

Returning to the embodiment, with the exception of scaling unit 20, the operation of the receiver chain is much the same as that described earlier with reference to Figure 1. In the embodiment, the scaling unit between the rake receiver and the codec evaluates the soft

decisions on the feedback path by determining their Q function value at a selectable amplitude level.

It is worth bearing in mind, as will be readily apparent to the skilled person, that the waveforms shown in Figures 2 to 6 are for the purposes of illustration only and that UMTS signals have a different appearance.

CLAIMS

1. A method of conditioning signal values being conveyed to a decoder in a wireless-communications network participant, the method comprising scaling the values, monitoring the probability distribution of the amplitudes of the scaled values and using the information gained through the monitoring step to determine if the degree of scaling should be adjusted.
2. A method according to claim 1, wherein the monitoring step comprises calculating a complementary cumulative probability density function for a signal value magnitude.
3. A method according to claim 1 or 2, wherein the monitoring step comprises determining the fraction of a group of signal values that exceed a certain magnitude.
4. A method according to claim 1, 2 or 3 wherein the decoder is a 3G telecommunications bit-rate signal decoder.
5. A wireless-communications network participant, comprising a decoder for decoding a signal received at the participant, scaling means for scaling values of the signal being conveyed to the decoder, monitoring means for monitoring the probability distribution of the amplitudes of the scaled values and control means for using information supplied by the monitoring means to determine if the degree of scaling should be adjusted.
6. A participant according to claim 5, wherein the monitoring means is arranged to calculate a complimentary cumulative probability density function for a signal value magnitude.
7. A participant according to claim 5 or 6, wherein the monitoring means is arranged to determine fraction of a group of signal values the exceed a certain magnitude.
8. A participant according to claim 5, 6 or 7, wherein the decoder is a 3G telecommunications bit-rate signal decoder.
9. A programme for causing data processing apparatus to carry out the method according to any one of claims 1 to 4.

10. A wireless-communications network participant, substantially as hereinbefore described with reference to Figures 1, 4 and 5.
11. A method of conditioning signal values being conveyed to a decoder in a wireless-communications network participant, the method being substantially as hereinbefore described with reference to Figures 1, 4 and 5.

ABSTRACT**PREPARATION OF SIGNALS FOR DECODING**

A wireless-communications unit has a receiver chain including a codec decoding the output of a rake receiver. Soft decisions passing from the rake receiver to the codec are scaled. The scaling factor can be tuned by monitoring a function based on the cumulative probability distribution function of the scaled soft decisions.

(Figure 1)

11/11/11 11:11 AM
11/11/11 11:11 AM
11/11/11 11:11 AM

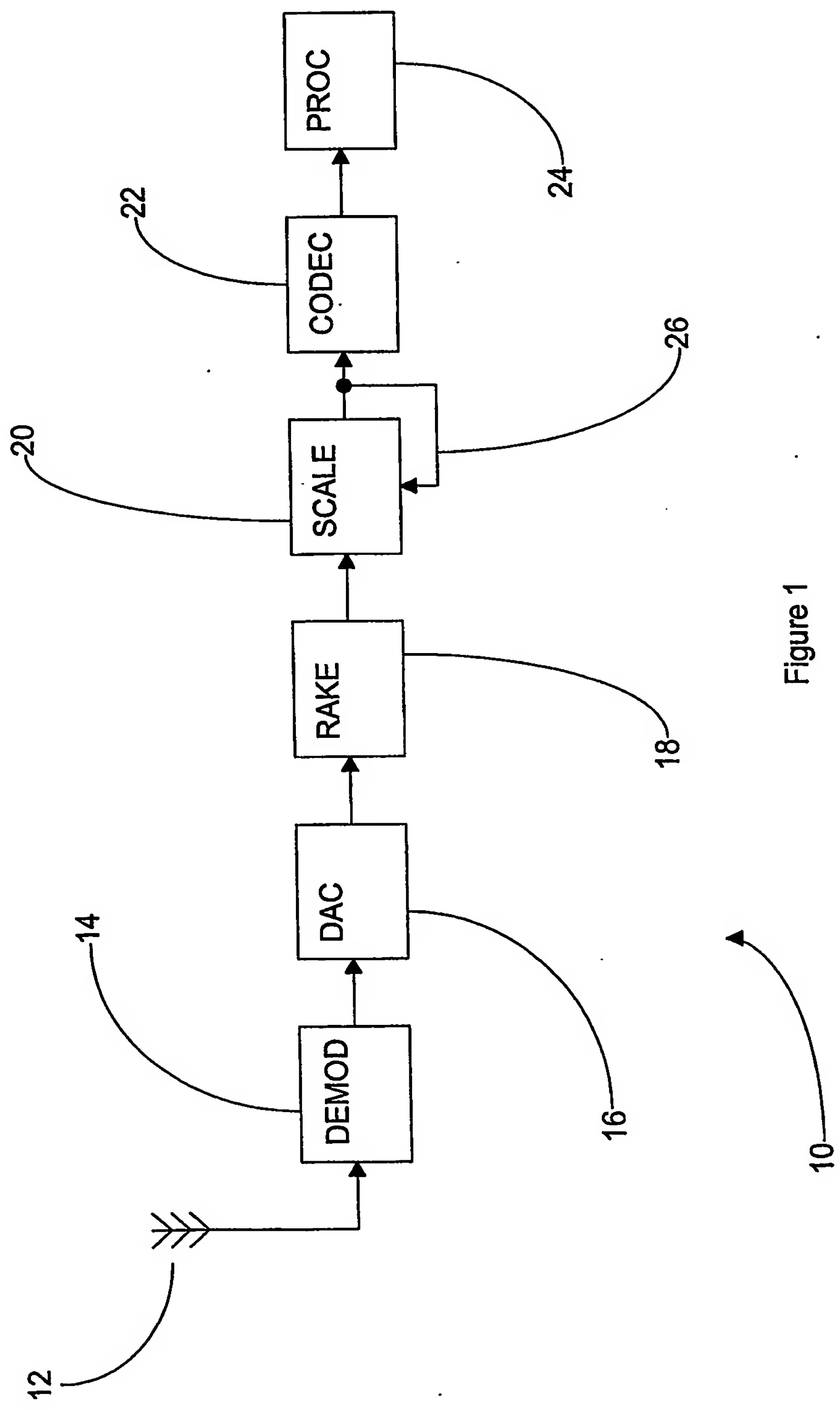


Figure 1

CENTRAL TOWNSHIP

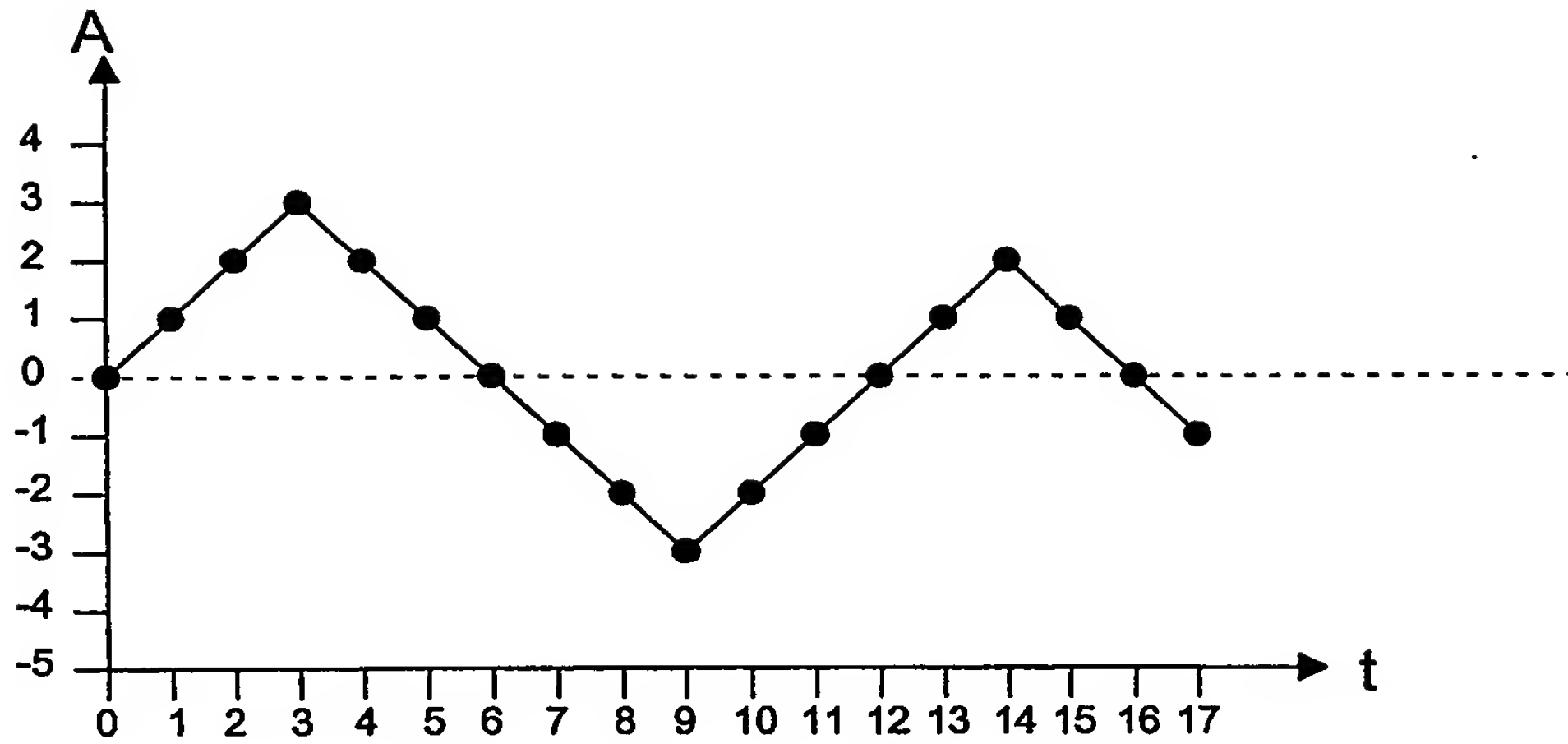


Figure 2

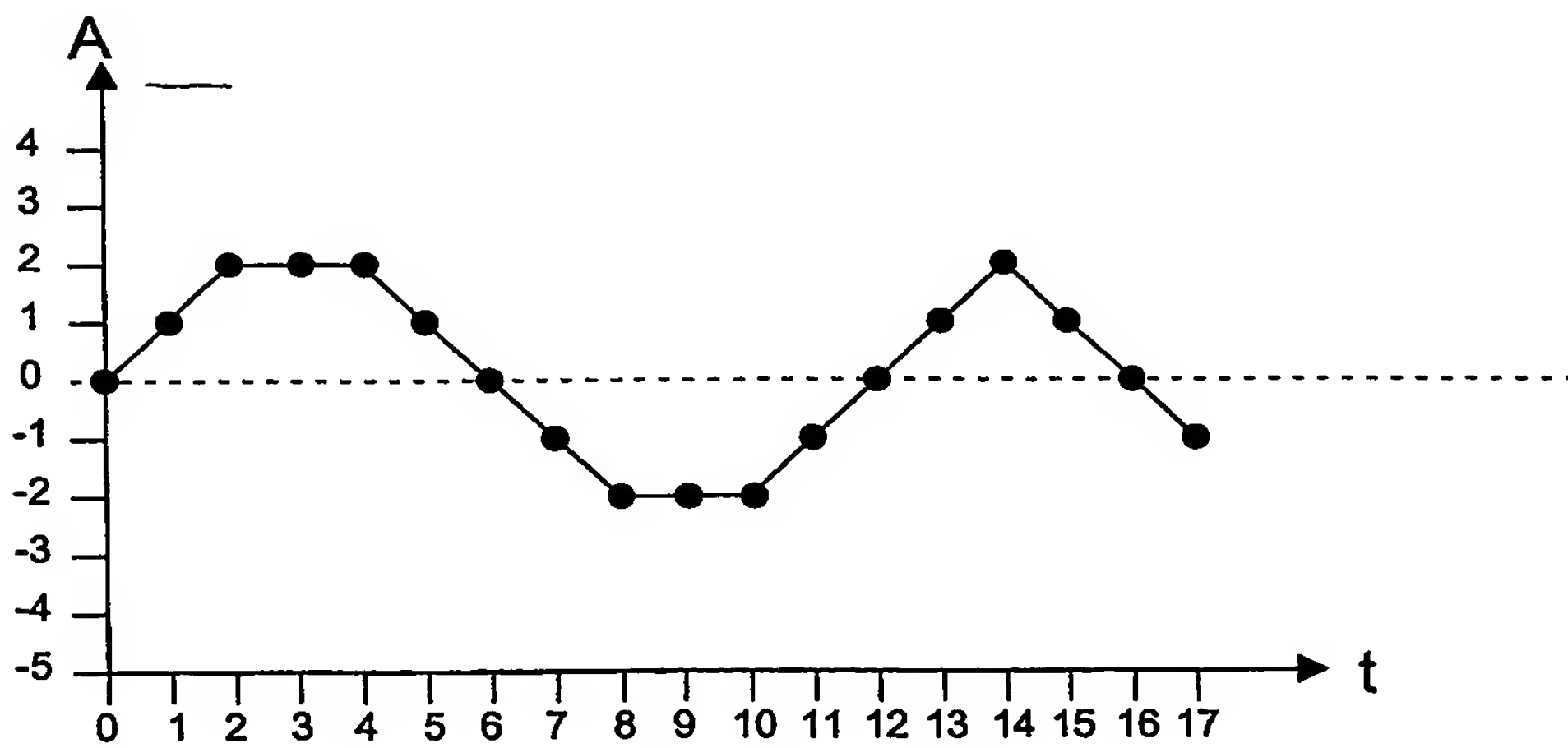


Figure 3

3/4

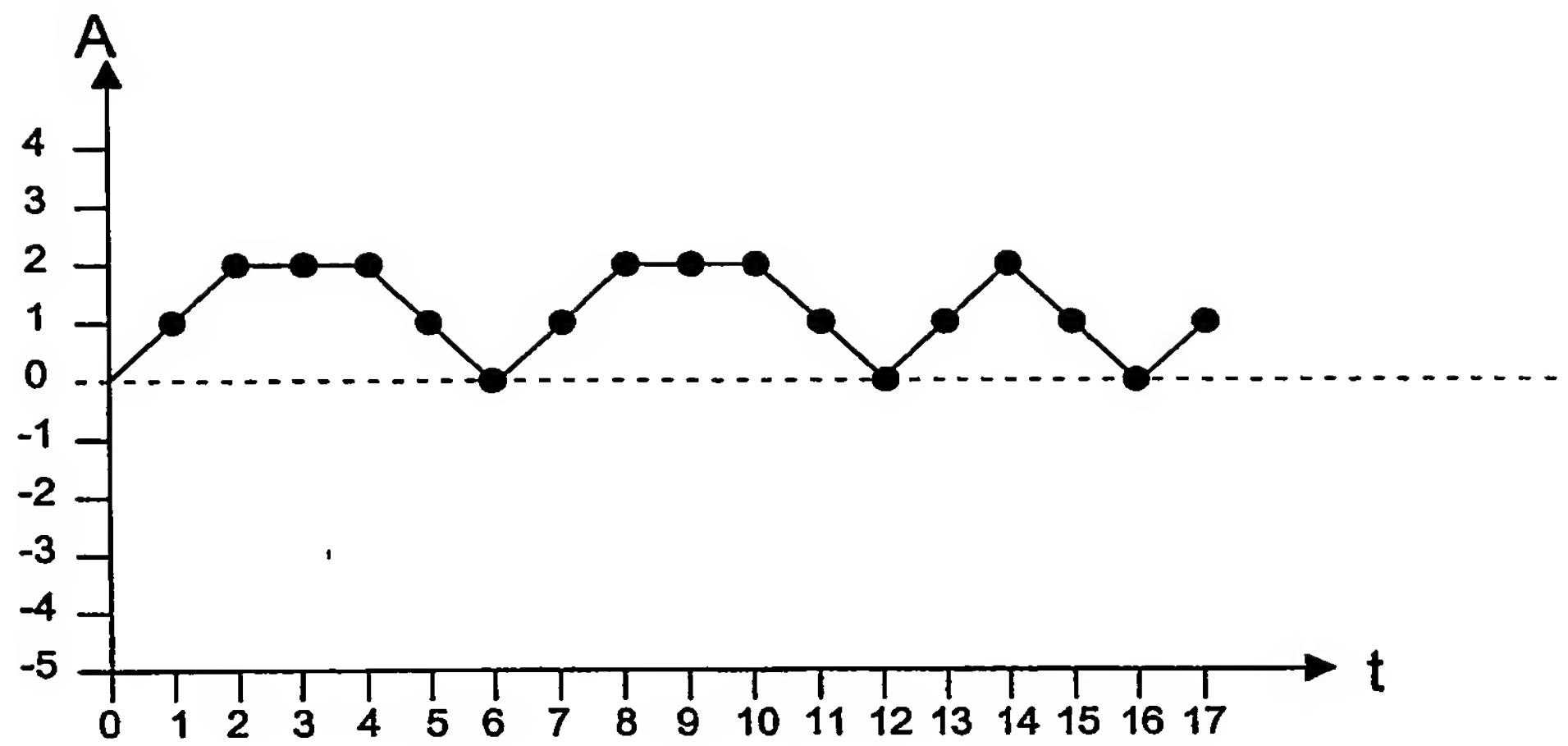


Figure 4

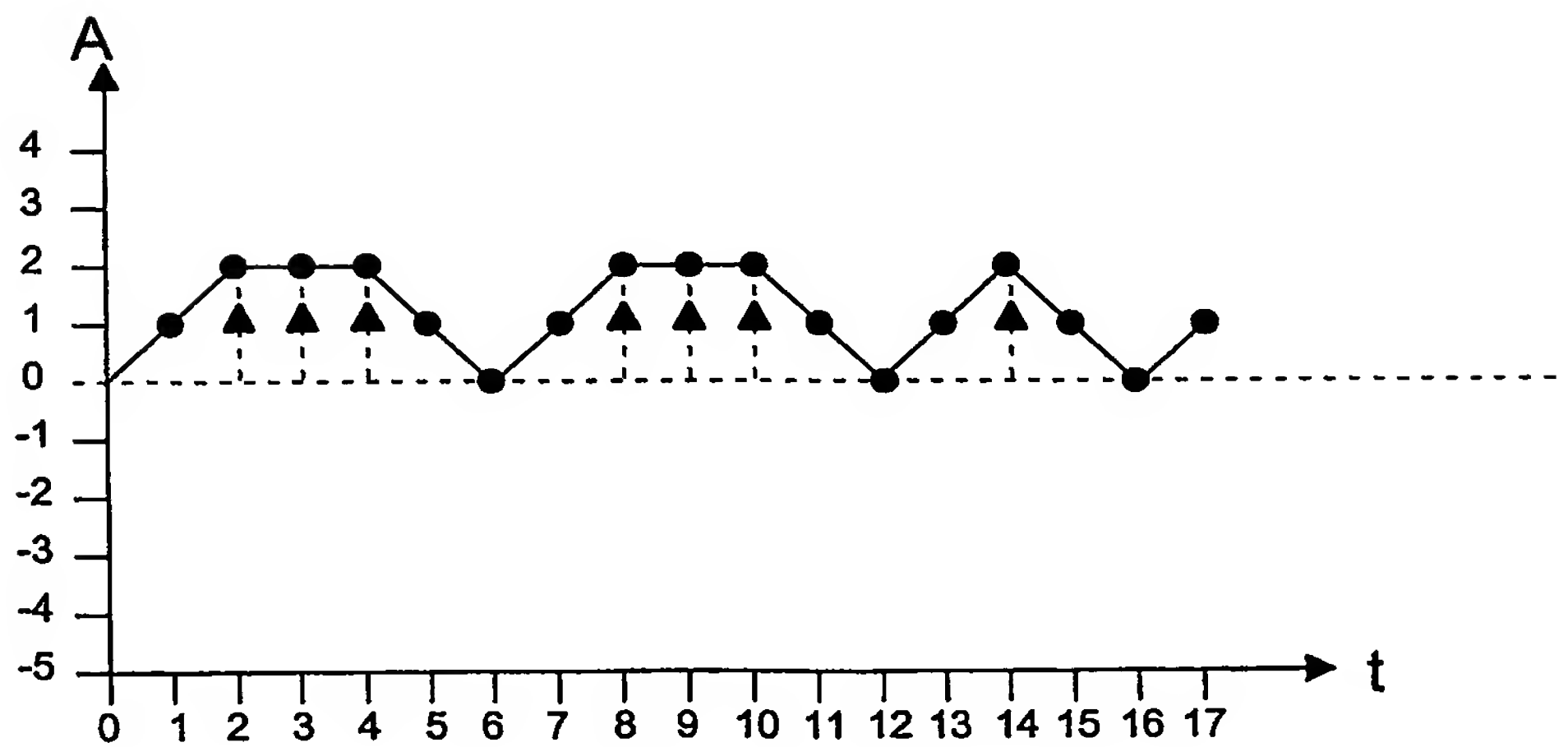


Figure 5



Figure 6